Homework #4

Phys 2220

1. In the figure below, what is the strength and direction of the magnetic field at:
   (a) point 1
   (b) point 2
   (c) point 3

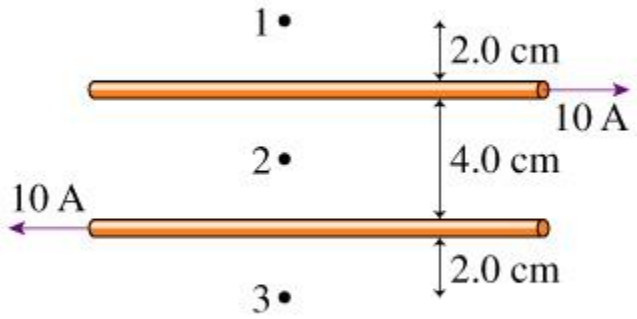

Figure 1: For Problem 1.

2. There has been concern in recent years over possible health effects from the magnetic fields generated by transmission lines, although the scientific evidence shows that this is not the case. A typical high-voltage transmission line is 20 m off the ground and carries a current of 200 A.
   (a) At the ground, what is the strength (magnitude) of the magnetic field produced by this wire?
   (b) What is the ratio of this magnetic field to the magnetic field the Earth produces?

3. Two concentric current loops lie in the same plane. The smaller loop has a radius of 3.0 cm and a current of 12 A. The bigger loop has a current of 20 A. The magnetic field at the center of the loops is found to be zero. What is the radius of the bigger loop?

4. A researcher would like to perform an experiment in a zero magnetic field, which means that the field of the earth must be cancelled. Suppose the experiment is done inside a solenoid of diameter 1.4 m, length 5.0 m, with a total of 6000 turns of wire. The solenoid is oriented to produce a field that opposes and exactly cancels the field of the earth. What current is needed in the solenoid's wire?

5. An alpha particle travels at a velocity v of magnitude 550 m/s through a uniform magnetic field B of magnitude 0.045 T. (An alpha particle has a charge of $+3.2\times 10^{-19}$ C and a mass of 6.6×10^{-27} kg.) The angle between v and B is 52^{o}. What are the magnitudes of
   (a) the force F acting on the particle due to the field and
   (b) the acceleration of the particle due to F?
   (c) Does the speed of the particle increase, decrease, or remain equal to 550 m/s?

6. What is the magnitude and direction of the force experienced by an electron that moves as shown in figure (a) and (b) below?

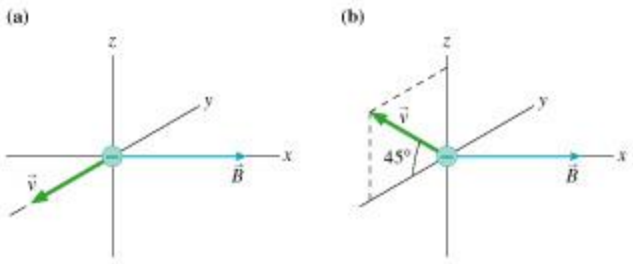

Figure 2: For Problem 6.

7. A proton travels through uniform magnetic and electric fields. The magnetic field B = 2.5 mT in the negative x direction (left). At one instant the velocity of the proton is v = 2000 m/s in the positive y direction (up). At that instant, what is the magnitude of the net force acting on the proton if the electric field is
   (a) zero, no electric field
   (b) E = 4.0 V/m in the positive z direction (out of the page)

8. An electron is accelerated from rest by a potential difference of 350 V. It then enters a uniform magnetic field of magnitude 200 mT with its velocity perpendicular to the field. Calculate
   (a) the speed of the electron and
   (b) the radius of its path in the magnetic field.

9. Physicist S. A. Goudsmit devised a method for measuring accurately the masses of heavy ions by timing their periods of revolution in a known magnetic field. A singly charged ion of iodine makes 7.00 rev in a field of 45.0 mT in 1.29 ms. Calculate its mass, in atomic mass units (u). Actually, the mass measurements are carried out to much greater accuracy than these approximate data suggest.

10. A wire of 62.0 cm length and 13.0 g mass is suspended by a pair of flexible leads in a magnetic field of 0.440 T, as shown below. What are the magnitude and direction of the current required to remove the tension in the supporting leads?

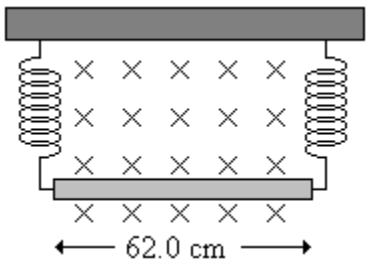

Figure 3: For Problem 10.

11. A current loop in a motor has an area of 0.85 cm^2 . It carries a 240 mA current in a uniform field of 0.62 T. What is the magnitude of the maximum torque on the wire?

12. Which drawing is correct for the orientation of a compass placed on a current carrying wire? (shaded = North, white = South)

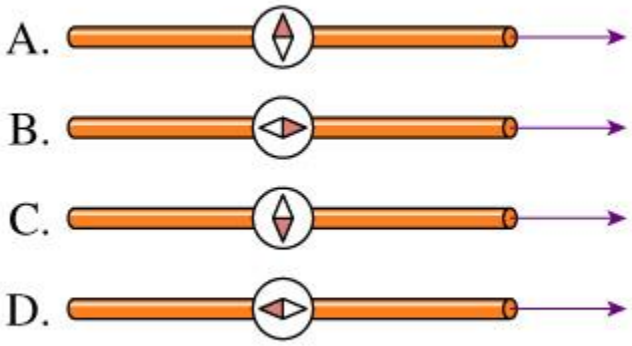

Figure 4: For Problem 12.

13. Which particle has the largest mass?

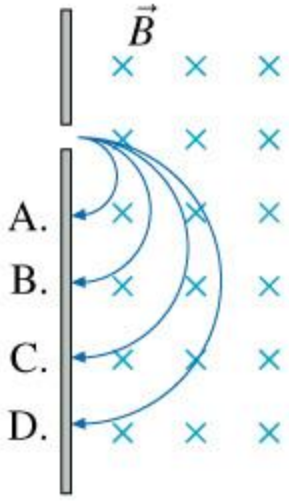

Figure 5: For Problem 13.

14. If the particle paths shown below are for electrons, what is the direction of the magnetic field?

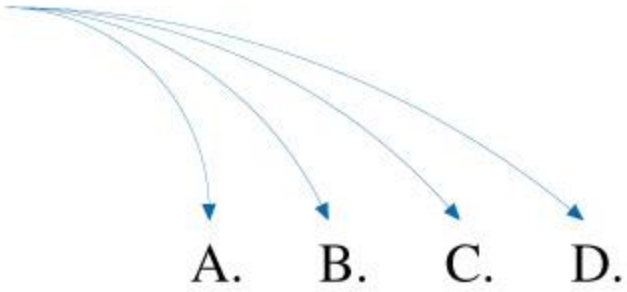

Figure 6: For Problem 14.